

# SEQUENCE LISTING

<110> Koffas, Mattheos  
 Odom, J. Martin  
 Schenzle, Andreas J.  
 Norton, Kelley C.  
 Tomb, Jean-Francois  
 Rouviere, Pierre  
 Picataggio, Stephen  
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<120> Genes Involved in Isoprenoid Compounds Production

<130> CL1646 US NA

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<150> 60/229,907

<151> September 1, 2001

<160> 24

<170> Microsoft Office 97

<210> 1

<211> 1860

<212> DNA

<213> Methylomonas 16a

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<223> ORF1

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<212> PRT

<213> Methylomonas 16a

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<223> Amino acid sequences encoded by ORF1

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Glu Val Arg Gly Tyr Leu Thr His Thr Val Ser Ile Ser Gly Gly His
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Phe Ala Ala Gly Leu Gly Thr Val Glu Leu Thr Val Ala Leu His Tyr
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Val Phe Asn Thr Pro Val Asp Gln Leu Val Trp Asp Val Gly His Gln
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Ala Tyr Pro His Lys Ile Leu Thr Gly Arg Lys Glu Arg Met Pro Thr
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Glu Tyr Asp Ala Phe Gly Val Gly His Ser Ser Thr Ser Ile Ser Ala
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Ala Leu Gly Met Ala Ile Ala Ser Gln Leu Arg Gly Glu Asp Lys Lys
      130                     135                     140

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Glu Ala Met Asn His Ala Gly Asp Val Asn Ala Asn Leu Leu Val Ile
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Leu Asn Asp Asn Asp Met Ser Ile Ser Pro Pro Val Gly Ala Met Asn
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Asn Tyr Leu Thr Lys Val Leu Ser Ser Lys Phe Tyr Ser Ser Val Arg
      195                     200                     205

Glu Glu Ser Lys Lys Ala Leu Ala Lys Met Pro Ser Val Trp Glu Leu
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Gly	Pro	Val	Phe	Leu	His	Val	Val	Thr	Lys	Lys	Gly	Lys	Gly	Tyr	Ala	275	280	285	
Pro	Ala	Glu	Lys	Asp	Pro	Leu	Ala	Tyr	His	Gly	Val	Pro	Ala	Phe	Asp	290	295	300	
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Glu	Arg	Leu	Leu	Gly	Ile	Thr	Pro	Ala	Met	Arg	Glu	Gly	Ser	Gly	Leu	340	345	350	
Val	Glu	Phe	Ser	Gln	Lys	Phe	Pro	Asn	Arg	Tyr	Phe	Asp	Val	Ala	Ile	355	360	365	
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Ala	Lys	Pro	Val	Val	Ala	Ile	Tyr	Ser	Thr	Phe	Leu	Gln	Arg	Gly	Tyr	385	390	395	400
Asp	Gln	Leu	Ile	His	Asp	Val	Ala	Leu	Gln	Asn	Leu	Asp	Met	Leu	Phe	405	410	415	
Ala	Leu	Asp	Arg	Ala	Gly	Leu	Val	Gly	Pro	Asp	Gly	Pro	Thr	His	Ala	420	425	430	
Gly	Ala	Phe	Asp	Tyr	Ser	Tyr	Met	Arg	Cys	Ile	Pro	Asn	Met	Leu	Ile	435	440	445	
Met	Ala	Pro	Ala	Asp	Glu	Asn	Glu	Cys	Arg	Gln	Met	Leu	Thr	Thr	Gly	450	455	460	
Phe	Gln	His	His	Gly	Pro	Ala	Ser	Val	Arg	Tyr	Pro	Arg	Gly	Lys	Gly	465	470	475	480
Pro	Gly	Ala	Ala	Ile	Asp	Pro	Thr	Leu	Thr	Ala	Leu	Glu	Ile	Gly	Lys	485	490	495	
Ala	Glu	Val	Arg	His	His	Gly	Ser	Arg	Ile	Ala	Ile	Leu	Ala	Trp	Gly	500	505	510	
Ser	Met	Val	Thr	Pro	Ala	Val	Glu	Ala	Gly	Lys	Gln	Leu	Gly	Ala	Thr	515	520	525	
Val	Val	Asn	Met	Arg	Phe	Val	Lys	Pro	Phe	Asp	Gln	Ala	Leu	Val	Leu	530	535	540	

Glu Leu Ala Arg Thr His Asp Val Phe Val Thr Val Glu Glu Asn Val  
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 Lys Val Leu Met Pro Val Cys Asn Ile Gly Leu Pro Asp Arg Phe Val  
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 Glu Gln Gly Ser Arg Glu Glu Leu Leu Ser Leu Val Gly Leu Asp Ser  
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 <213> *Methylobacterium* 16a

<220>  
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 aaggtagcag agttcaaaca gcgcattgcc gcttcgccgg tagcggatat caaggtcttg 240  
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 <213> *Methylobacterium* 16a

<220>  
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Leu	Thr	Ala	Asn	Gly	Asn	Ile	Asp	Ala	Leu	Tyr	Glu	Gln	Cys	Leu	Ala	
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His	His	Pro	Glu	Tyr	Ala	Val	Val	Val	Met	Glu	Ser	Lys	Val	Ala	Glu	
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Phe	Lys	Gln	Arg	Ile	Ala	Ala	Ser	Pro	Val	Ala	Asp	Ile	Lys	Val	Leu	
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Ser	Gly	Ser	Glu	Ala	Leu	Gln	Gln	Val	Ala	Thr	Leu	Glu	Asn	Val	Asp	
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Thr	Val	Met	Ala	Ala	Ile	Val	Gly	Ala	Ala	Gly	Leu	Leu	Pro	Thr	Leu	
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Ala	Ala	Ala	Lys	Ala	Gly	Lys	Thr	Val	Leu	Leu	Ala	Asn	Lys	Glu	Ala	
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Leu	Val	Met	Ser	Gly	Gln	Ile	Phe	Met	Gln	Ala	Val	Ser	Asp	Ser	Gly	
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Ala	Val	Leu	Leu	Pro	Ile	Asp	Ser	Glu	His	Asn	Ala	Ile	Phe	Gln	Cys	
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Thr	Leu	Ser	Ser	Val	Thr	Pro	Asp	Gln	Ala	Val	Ala	His	Pro	Lys	Trp	
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	210					215					220					
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Ala Val Ile Ile Glu Arg Ser Met Ala Gln Phe Lys Pro Asp Asp Ala  
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<213> Methylomonas 16a

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gaaaatgatt ggggtgctggt acacgacgcc gcccgcccct gcttgacggg cagcgacatc 360  
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<213> Methylomonas 16a

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35 40 45

Ala Phe Gln Lys Val Ala Val Ala Ile Ser Val Glu Asp Pro Tyr Trp  
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<212> PRT

<213> Methylomonas 16a

<220>

<223> Amino acid sequences encoded by ORF4

<400> 8

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Leu	Leu	Gln	Thr	Val	Phe	Gln	Met	Leu	Asp	Leu	Cys	Asp	Trp	Leu	Thr
		35					40					45			
Phe	His	Pro	Val	Asp	Asp	Gly	Arg	Val	Thr	Leu	Arg	Asn	Pro	Ile	Ser
	50					55					60				
Gly	Val	Pro	Glu	Gln	Asp	Asp	Leu	Thr	Val	Arg	Ala	Ala	Asn	Leu	Leu
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Lys	Ser	His	Thr	Gly	Cys	Val	Arg	Gly	Val	Cys	Ile	Asp	Ile	Glu	Lys
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Asn	Leu	Pro	Met	Gly	Gly	Gly	Leu	Gly	Gly	Gly	Ser	Ser	Asp	Ala	Ala
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Thr	Thr	Leu	Val	Val	Leu	Asn	Arg	Leu	Trp	Gly	Leu	Gly	Leu	Ser	Lys
		115					120					125			
Arg	Glu	Leu	Met	Asp	Leu	Gly	Leu	Arg	Leu	Gly	Ala	Asp	Val	Pro	Val
	130					135					140				
Phe	Val	Phe	Gly	Cys	Ser	Ala	Trp	Gly	Glu	Gly	Val	Ser	Glu	Asp	Leu
145					150					155					160
Gln	Ala	Ile	Thr	Leu	Pro	Glu	Gln	Trp	Phe	Val	Ile	Ile	Lys	Pro	Asp
				165					170					175	
Cys	His	Val	Asn	Thr	Gly	Glu	Ile	Phe	Ser	Ala	Glu	Asn	Leu	Thr	Arg
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Asn	Ser	Ala	Val	Val	Thr	Met	Ser	Asp	Phe	Leu	Ala	Gly	Asp	Asn	Arg
		195					200					205			
Asn	Asp	Cys	Ser	Glu	Val	Val	Cys	Lys	Leu	Tyr	Arg	Pro	Val	Lys	Asp
	210					215					220				
Ala	Ile	Asp	Ala	Leu	Leu	Cys	Tyr	Ala	Glu	Ala	Arg	Leu	Thr	Gly	Thr
225					230					235					240
Gly	Ala	Cys	Val	Phe	Ala	Gln	Phe	Cys	Asn	Lys	Glu	Asp	Ala	Glu	Ser
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Ala	Leu	Glu	Gly	Leu	Lys	Asp	Arg	Trp	Leu	Val	Phe	Leu	Ala	Lys	Gly
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Leu	Asn	Gln	Ser	Ala	Leu	Tyr	Lys	Lys	Leu	Glu	Gln	Gly			
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 <213> Methylomonas 16a

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 <211> 157  
 <212> PRT  
 <213> Methylomonas 16a

<220>  
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 Glu Ala His Ser Asp Gly Asp Val Val Leu His Ala Leu Ala Asp Ala  
 35 40 45  
 Ile Leu Gly Ala Ala Ala Leu Gly Asp Ile Gly Lys His Phe Pro Asp  
 50 55 60  
 Thr Asp Pro Asn Phe Lys Gly Ala Asp Ser Arg Val Leu Leu Arg His  
 65 70 75 80  
 Val Tyr Gly Ile Val Lys Glu Lys Gly Tyr Lys Leu Val Asn Ala Asp  
 85 90 95  
 Val Thr Ile Ile Ala Gln Ala Pro Lys Met Leu Pro His Val Pro Gly  
 100 105 110  
 Met Arg Ala Asn Ile Ala Ala Asp Leu Glu Thr Asp Val Asp Phe Ile  
 115 120 125  
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<210> 11  
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 <212> DNA  
 <213> Methylobionas 16a

<220>  
 <223> ORF6

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 gaagccggcg aactggtcac acgcgacgaa gattccgatc tggcgggcac gatgcgtctg 1320  
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 gtcacaccg agcgtcaccg ccaccgctac gaattcaaca atcaatattt aaaacaactg 1440  
 gaagcggcgg gcatgaaatt ttccggtaaa tcgctggacg gccgcctggt ggagatcatc 1500  
 gagctaccg aacacccctg gttcctggcc tgccagttcc atcccgaatt cacctcgacg 1560  
 ccgcgtaacg gccacgcctt attttcgggc ttcgtcgaag cggccgcaa acacaaaaca 1620  
 caaggcacag ca 1632

<210> 12  
 <211> 544  
 <212> PRT  
 <213> Methylobionas 16a

<220>  
 <223> Amino acid sequences encoded by ORF6

<400> 12  
 Met Thr Lys Phe Ile Phe Ile Thr Gly Gly Val Val Ser Ser Leu Gly  
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 Lys Gly Ile Ala Ala Ser Ser Leu Ala Ala Ile Leu Glu Asp Arg Gly  
 20 25 30  
 Leu Lys Val Thr Ile Thr Lys Leu Asp Pro Tyr Ile Asn Val Asp Pro  
 35 40 45  
 Gly Thr Met Ser Pro Phe Gln His Gly Glu Val Phe Val Thr Glu Asp  
 50 55 60

Gly	Ala	Glu	Thr	Asp	Leu	Asp	Leu	Gly	His	Tyr	Glu	Arg	Phe	Leu	Lys	65	70	75	80
Thr	Thr	Met	Thr	Lys	Lys	Asn	Asn	Phe	Thr	Thr	Gly	Gln	Val	Tyr	Glu	85	90	95	
Gln	Val	Leu	Arg	Asn	Glu	Arg	Lys	Gly	Asp	Tyr	Leu	Gly	Ala	Thr	Val	100	105	110	
Gln	Val	Ile	Pro	His	Ile	Thr	Asp	Glu	Ile	Lys	Arg	Arg	Val	Tyr	Glu	115	120	125	
Ser	Ala	Glu	Gly	Lys	Asp	Val	Ala	Leu	Ile	Glu	Val	Gly	Gly	Thr	Val	130	135	140	
Gly	Asp	Ile	Glu	Ser	Leu	Pro	Phe	Leu	Glu	Thr	Ile	Arg	Gln	Met	Gly	145	150	155	160
Val	Glu	Leu	Gly	Arg	Asp	Arg	Ala	Leu	Phe	Ile	His	Leu	Thr	Leu	Val	165	170	175	
Pro	Tyr	Ile	Lys	Ser	Ala	Gly	Glu	Leu	Lys	Thr	Lys	Pro	Thr	Gln	His	180	185	190	
Ser	Val	Lys	Glu	Leu	Arg	Thr	Ile	Gly	Ile	Gln	Pro	Asp	Ile	Leu	Ile	195	200	205	
Cys	Arg	Ser	Glu	Gln	Pro	Ile	Pro	Ala	Ser	Glu	Arg	Arg	Lys	Ile	Ala	210	215	220	
Leu	Phe	Thr	Asn	Val	Ala	Glu	Lys	Ala	Val	Ile	Ser	Ala	Ile	Asp	Ala	225	230	235	240
Asp	Thr	Ile	Tyr	Arg	Ile	Pro	Leu	Leu	Leu	Arg	Glu	Gln	Gly	Leu	Asp	245	250	255	
Asp	Leu	Val	Val	Asp	Gln	Leu	Arg	Leu	Asp	Val	Pro	Ala	Ala	Asp	Leu	260	265	270	
Ser	Ala	Trp	Glu	Lys	Val	Val	Asp	Gly	Leu	Thr	His	Pro	Thr	Asp	Glu	275	280	285	
Val	Ser	Ile	Ala	Ile	Val	Gly	Lys	Tyr	Val	Asp	His	Thr	Asp	Ala	Tyr	290	295	300	
Lys	Ser	Leu	Asn	Glu	Ala	Leu	Ile	His	Ala	Gly	Ile	His	Thr	Arg	His	305	310	315	320
Lys	Val	Gln	Ile	Ser	Tyr	Ile	Asp	Ser	Glu	Thr	Ile	Glu	Ala	Glu	Gly	325	330	335	
Thr	Ala	Lys	Leu	Lys	Asn	Val	Asp	Ala	Ile	Leu	Val	Pro	Gly	Gly	Phe	340	345	350	
Gly	Glu	Arg	Gly	Val	Glu	Gly	Lys	Ile	Ser	Thr	Val	Arg	Phe	Ala	Arg	355	360	365	
Glu	Asn	Lys	Ile	Pro	Tyr	Leu	Gly	Ile	Cys	Leu	Gly	Met	Gln	Ser	Ala	370	375	380	

Val Ile Glu Phe Ala Arg Asn Val Val Gly Leu Glu Gly Ala His Ser  
385 390 395 400

Thr Glu Phe Leu Pro Lys Ser Pro His Pro Val Ile Gly Leu Ile Thr  
405 410 415

Glu Trp Met Asp Glu Ala Gly Glu Leu Val Thr Arg Asp Glu Asp Ser  
420 425 430

Asp Leu Gly Gly Thr Met Arg Leu Gly Ala Gln Lys Cys Arg Leu Lys  
435 440 445

Ala Asp Ser Leu Ala Phe Gln Leu Tyr Gln Lys Asp Val Ile Thr Glu  
450 455 460

Arg His Arg His Arg Tyr Glu Phe Asn Asn Gln Tyr Leu Lys Gln Leu  
465 470 475 480

Glu Ala Ala Gly Met Lys Phe Ser Gly Lys Ser Leu Asp Gly Arg Leu  
485 490 495

Val Glu Ile Ile Glu Leu Pro Glu His Pro Trp Phe Leu Ala Cys Gln  
500 505 510

Phe His Pro Glu Phe Thr Ser Thr Pro Arg Asn Gly His Ala Leu Phe  
515 520 525

Ser Gly Phe Val Glu Ala Ala Ala Lys His Lys Thr Gln Gly Thr Ala  
530 535 540

<210> 13

<211> 891

<212> DNA

<213> Methylobionas 16a

<220>

<223> ORF7

<400> 13

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gtattgaacg gcggcaaacg caccgggcc ttgttgactt atgcgaccgg tcaggctttg 180
ggcttgccgg aaaacgtgct ggatgcgccg gcttgcgcgg tagaattcat ccatgtgtat 240
tcgctgattc acgacgatct gccggccatg gacaacgatg atctgcgccg cggcaaacgg 300
acctgtcaca aggtttacga cgaggccacc gccattttgg ccggcgacgc actgcaggcg 360
ctggcctttg aagttctggc caacgacccc ggcatcaccg tcgatgcccc ggctcgcttg 420
aaaatgatca cggctttgac ccgcgccagc ggctctcaag gcatgggtggg cggctcaagcc 480
atcgatctcg gctcgcgcgg ccgcaaattg acgctgcgcg aactcgaaaa catgcatatc 540
cacaagactg gcgccctgat ccgcgccagc gtcaatctgg cggcattatc caaacccgat 600
ctggatactt gcgtcgccaa gaaactggat cactatgcca aatgcatagg cttgtcgttc 660
caggtcaaag acgacattct cgacatcgaa gccgacaccg cgacactcgg caagactcag 720
ggcaaggaca tcgataacga caaacccgacc taccctgcgc tattgggcat ggctggcgcc 780
aaacaaaaag cccaggaatt gcacgaacaa gcagtcgaaa gcttaacggg atttggcagc 840
gaagccgacc tgctgcgcga actatcgctt tacatcatcg agcgcacgca c 891

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<210> 14

<211> 297

<212> PRT

<213> Methylobionas 16a

<220>

<223> Amino acid sequences encoded by ORF7

<400> 14

Met Ser Lys Leu Lys Ala Tyr Leu Thr Val Cys Gln Glu Arg Val Glu  
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Arg Ala Leu Asp Ala Arg Leu Pro Ala Glu Asn Ile Leu Pro Gln Thr  
20 25 30  
Leu His Gln Ala Met Arg Tyr Ser Val Leu Asn Gly Gly Lys Arg Thr  
35 40 45  
Arg Pro Leu Leu Thr Tyr Ala Thr Gly Gln Ala Leu Gly Leu Pro Glu  
50 55 60  
Asn Val Leu Asp Ala Pro Ala Cys Ala Val Glu Phe Ile His Val Tyr  
65 70 75 80  
Ser Leu Ile His Asp Asp Leu Pro Ala Met Asp Asn Asp Asp Leu Arg  
85 90 95  
Arg Gly Lys Pro Thr Cys His Lys Ala Tyr Asp Glu Ala Thr Ala Ile  
100 105 110  
Leu Ala Gly Asp Ala Leu Gln Ala Leu Ala Phe Glu Val Leu Ala Asn  
115 120 125  
Asp Pro Gly Ile Thr Val Asp Ala Pro Ala Arg Leu Lys Met Ile Thr  
130 135 140  
Ala Leu Thr Arg Ala Ser Gly Ser Gln Gly Met Val Gly Gly Gln Ala  
145 150 155 160  
Ile Asp Leu Gly Ser Val Gly Arg Lys Leu Thr Leu Pro Glu Leu Glu  
165 170 175  
Asn Met His Ile His Lys Thr Gly Ala Leu Ile Arg Ala Ser Val Asn  
180 185 190  
Leu Ala Ala Leu Ser Lys Pro Asp Leu Asp Thr Cys Val Ala Lys Lys  
195 200 205  
Leu Asp His Tyr Ala Lys Cys Ile Gly Leu Ser Phe Gln Val Lys Asp  
210 215 220  
Asp Ile Leu Asp Ile Glu Ala Asp Thr Ala Thr Leu Gly Lys Thr Gln  
225 230 235 240  
Gly Lys Asp Ile Asp Asn Asp Lys Pro Thr Tyr Pro Ala Leu Leu Gly  
245 250 255  
Met Ala Gly Ala Lys Gln Lys Ala Gln Glu Leu His Glu Gln Ala Val  
260 265 270  
Glu Ser Leu Thr Gly Phe Gly Ser Glu Ala Asp Leu Leu Arg Glu Leu  
275 280 285

Ser Leu Tyr Ile Ile Glu Arg Thr His  
290 295

<210> 15  
<211> 1533  
<212> DNA  
<213> Methylobionas 16a

<220>  
<223> ORF8

<400> 15  
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atgttgctga gccagcgcggt cttcaaggta tcgatttttcg acaaacatgc agaaatcggc 120  
ggcgcgaacc gccgatcaa catgaacggc tttaccttcg ataccgggtcc gacattcttg 180  
ttgatgaaag gcgtgctgga cgaaatgttc gaactgtgag agcgccgtag cgaggattat 240  
ctggaattcc tgccgctaag cccgatgtac cgctgtgtgt acgacgaccg cgacatcttc 300  
gtctattccg accgcgagaa catgcgcgcc gaattgcaac gggatttcga cgaaggcagc 360  
gacggctacg aacagttcat ggaacaggaa cgcaaacgct tcaacgcgct gtatccctgc 420  
atcaccgcgc attattccag cctgaaatcc tttttgtcgc tggacttgat caaggccctg 480  
ccgtgggtgg cttttccgaa aagcgtgttc aataatctcg gccagtattt caaccaggaa 540  
aaaatgcgcc tggccttttg ctttcagtcg aagtatctgg gcatgtcgcc gtgggaatgc 600  
ccggcactgt ttacgatgct gccctatctg gagcacgaat acggcattta tcacgtcaaa 660  
ggcggcctga accgcacgcg ggcggcgatg gcgcaagtga tcgcggaaaa cggcggcgaa 720  
attcacttga acagcgaat cgagtcgctg atcatcgaaa acggcgctgc caaggcgctc 780  
aaattacaac atggcgcgga gctgcgcggc gacgaagtca tcatcaacgc ggattttgcc 840  
cacgcgatga cgcacgtggt caaacggggc gtcttgaaaa aatacaccgc ggaaaacctg 900  
aagcagcgcg agtattcttg ttgcaccttc atgctgtatc tgggtttgga caagatttac 960  
gatctgccgc accataccat cgtgtttgcc aaggattaca ccaccaatat ccgcaacatt 1020  
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gacgacagcc tagcgccagc cggcaaatcg gcgctgtacg tgctgggtgc gatgcccaac 1140  
aacgacagcg gcctggactg gcaggcgcat tgccaaaacg tcgcggaaca ggtgttgga 1200  
acgctgggag cgcgactggg attgagcgac atcagagccc atatcgaatg cgaaaaaatc 1260  
atcacgccgc aaacctggga aacggacgaa cacgtttaca agggcgccac tttcagtttg 1320  
tcgcacaagt tcagccaaat gctgtactgg cggccgcaca accgtttcga ggaactggcc 1380  
aattgctatc tggtcggcgg cggcacgcac cccggtagcg gtttgccgac catctacgaa 1440  
tcggcgcgga tttcgcccaa gctgatttcc cagaaacatc gggtagaggt caaggacata 1500  
gcacacagcg cctgggtgaa aaaagccaaa gcc 1533

<210> 16  
<211> 511  
<212> PRT  
<213> Methylobionas 16a

<220>  
<223> Amino acid sequences encoded by ORF8

<400> 16  
Met Ala Asn Thr Lys His Ile Ile Ile Val Gly Ala Gly Pro Gly Gly  
1 5 10 15  
Leu Cys Ala Gly Met Leu Leu Ser Gln Arg Gly Phe Lys Val Ser Ile  
20 25 30  
Phe Asp Lys His Ala Glu Ile Gly Gly Arg Asn Arg Pro Ile Asn Met  
35 40 45

Asn	Gly	Phe	Thr	Phe	Asp	Thr	Gly	Pro	Thr	Phe	Leu	Leu	Met	Lys	Gly	50	55	60	
Val	Leu	Asp	Glu	Met	Phe	Glu	Leu	Cys	Glu	Arg	Arg	Ser	Glu	Asp	Tyr	65	70	75	80
Leu	Glu	Phe	Leu	Pro	Leu	Ser	Pro	Met	Tyr	Arg	Leu	Leu	Tyr	Asp	Asp	85	90	95	
Arg	Asp	Ile	Phe	Val	Tyr	Ser	Asp	Arg	Glu	Asn	Met	Arg	Ala	Glu	Leu	100	105	110	
Gln	Arg	Val	Phe	Asp	Glu	Gly	Thr	Asp	Gly	Tyr	Glu	Gln	Phe	Met	Glu	115	120	125	
Gln	Glu	Arg	Lys	Arg	Phe	Asn	Ala	Leu	Tyr	Pro	Cys	Ile	Thr	Arg	Asp	130	135	140	
Tyr	Ser	Ser	Leu	Lys	Ser	Phe	Leu	Ser	Leu	Asp	Leu	Ile	Lys	Ala	Leu	145	150	155	160
Pro	Trp	Leu	Ala	Phe	Pro	Lys	Ser	Val	Phe	Asn	Asn	Leu	Gly	Gln	Tyr	165	170	175	
Phe	Asn	Gln	Glu	Lys	Met	Arg	Leu	Ala	Phe	Cys	Phe	Gln	Ser	Lys	Tyr	180	185	190	
Leu	Gly	Met	Ser	Pro	Trp	Glu	Cys	Pro	Ala	Leu	Phe	Thr	Met	Leu	Pro	195	200	205	
Tyr	Leu	Glu	His	Glu	Tyr	Gly	Ile	Tyr	His	Val	Lys	Gly	Gly	Leu	Asn	210	215	220	
Arg	Ile	Ala	Ala	Ala	Met	Ala	Gln	Val	Ile	Ala	Glu	Asn	Gly	Gly	Glu	225	230	235	240
Ile	His	Leu	Asn	Ser	Glu	Ile	Glu	Ser	Leu	Ile	Ile	Glu	Asn	Gly	Ala	245	250	255	
Ala	Lys	Gly	Val	Lys	Leu	Gln	His	Gly	Ala	Glu	Leu	Arg	Gly	Asp	Glu	260	265	270	
Val	Ile	Ile	Asn	Ala	Asp	Phe	Ala	His	Ala	Met	Thr	His	Leu	Val	Lys	275	280	285	
Pro	Gly	Val	Leu	Lys	Lys	Tyr	Thr	Pro	Glu	Asn	Leu	Lys	Gln	Arg	Glu	290	295	300	
Tyr	Ser	Cys	Ser	Thr	Phe	Met	Leu	Tyr	Leu	Gly	Leu	Asp	Lys	Ile	Tyr	305	310	315	320
Asp	Leu	Pro	His	His	Thr	Ile	Val	Phe	Ala	Lys	Asp	Tyr	Thr	Thr	Asn	325	330	335	
Ile	Arg	Asn	Ile	Phe	Asp	Asn	Lys	Thr	Leu	Thr	Asp	Asp	Phe	Ser	Phe	340	345	350	
Tyr	Val	Gln	Asn	Ala	Ser	Ala	Ser	Asp	Asp	Ser	Leu	Ala	Pro	Ala	Gly	355	360	365	

Lys Ser Ala Leu Tyr Val Leu Val Pro Met Pro Asn Asn Asp Ser Gly  
 370 375 380  
 Leu Asp Trp Gln Ala His Cys Gln Asn Val Arg Glu Gln Val Leu Asp  
 385 390 395 400  
 Thr Leu Gly Ala Arg Leu Gly Leu Ser Asp Ile Arg Ala His Ile Glu  
 405 410 415  
 Cys Glu Lys Ile Ile Thr Pro Gln Thr Trp Glu Thr Asp Glu His Val  
 420 425 430  
 Tyr Lys Gly Ala Thr Phe Ser Leu Ser His Lys Phe Ser Gln Met Leu  
 435 440 445  
 Tyr Trp Arg Pro His Asn Arg Phe Glu Glu Leu Ala Asn Cys Tyr Leu  
 450 455 460  
 Val Gly Gly Gly Thr His Pro Gly Ser Gly Leu Pro Thr Ile Tyr Glu  
 465 470 475 480  
 Ser Ala Arg Ile Ser Ala Lys Leu Ile Ser Gln Lys His Arg Val Arg  
 485 490 495  
 Phe Lys Asp Ile Ala His Ser Ala Trp Leu Lys Lys Ala Lys Ala  
 500 505 510

<210> 17  
 <211> 1491  
 <212> DNA  
 <213> Methylobionas 16a

<220>  
 <223> ORF9

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 gtcggcggca agctcaacat catgacccaa gacggcttta ccttcgatct ggggccgtcc 180  
 attttgacga tgccgcacat ctttgaggcc ttgttcacag gggccggcaa aaacatggcc 240  
 gattacgtgc aaatccagaa agtcgaaccg cactggcgca atttcttcga ggacggtagc 300  
 gtgatcgact tgtgcaaga cgccgaaacc cagcgccgag agctggataa acttggcccc 360  
 ggcaattacg cgcaattcca gcgctttctg gactattcga aaaacctctg cacggaaacc 420  
 gaagccgggt acttcgcca gggcctggac ggcttttggg atttactcaa gttttacggc 480  
 ccgctccgca gcctgctgag ttctgacgtc ttccgcagca tggaccaggg cgtgcgccgc 540  
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 tcgccttacg atgcgcccgc cttgatgaac ctgctgcctt acattcaata tcattacggc 660  
 ctgtggttac tgaaaggcgg catgtatggc atggcgaggg ccatggaaaa actggccgtg 720  
 gaattgggag tcgagattcg tttgatggcc gaggtgtcgg aaatccaaaa acaggacggc 780  
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 aacatggaag tgattccggc gatggaaaaa ctgctgcgca gcccgccag cgaactgaaa 900  
 aaaatgcagc gcttcgagcc tagctgttcc ggctgggtgc tgcacttggg cgtggacagg 960  
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 gatgcggtat tcaaaagcca tcgcctgtcg gacgatccga ccatttatct ggtcgcgcgc 1080  
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 cgggtgctgg tcaaaactcg acgcatgggc ctgacggatt tacgccaaca catcgtgacc 1260  
 gaagaatact ggacgcccgt ggatattcag gccaaatatt attcaaacca gggctcgatt 1320  
 tacggcgtgg tcgccgaccg cttcaaaaac ctgggtttca aggcacctca acgcagcagc 1380



gaattatcca atctgtatatt cgctggcggc agcgtcaatc ccggcgggcgg catgccgatg 1440  
 gtgacgctgt ccgggcaatt ggtgaggac aagattgtgg cggatttgca a 1491

<210> 18

<211> 497

<212> PRT

<213> Methylomonas 16a

<220>

<223> Amino acid sequences encoded by ORF9

<400> 18

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Gly	Gly	Leu	Ser	Ala	Ala	Ile	Ser	Leu	Ala	Thr	Ala	Gly	Phe	Ser	Val	
			20					25					30			
Gln	Leu	Ile	Glu	Lys	Asn	Asp	Lys	Val	Gly	Gly	Lys	Leu	Asn	Ile	Met	
		35					40					45				
Thr	Lys	Asp	Gly	Phe	Thr	Phe	Asp	Leu	Gly	Pro	Ser	Ile	Leu	Thr	Met	
	50					55					60					
Pro	His	Ile	Phe	Glu	Ala	Leu	Phe	Thr	Gly	Ala	Gly	Lys	Asn	Met	Ala	
	65				70					75					80	
Asp	Tyr	Val	Gln	Ile	Gln	Lys	Val	Glu	Pro	His	Trp	Arg	Asn	Phe	Phe	
			85						90					95		
Glu	Asp	Gly	Ser	Val	Ile	Asp	Leu	Cys	Glu	Asp	Ala	Glu	Thr	Gln	Arg	
		100						105					110			
Arg	Glu	Leu	Asp	Lys	Leu	Gly	Pro	Gly	Thr	Tyr	Ala	Gln	Phe	Gln	Arg	
	115					120						125				
Phe	Leu	Asp	Tyr	Ser	Lys	Asn	Leu	Cys	Thr	Glu	Thr	Glu	Ala	Gly	Tyr	
	130					135					140					
Phe	Ala	Lys	Gly	Leu	Asp	Gly	Phe	Trp	Asp	Leu	Leu	Lys	Phe	Tyr	Gly	
	145				150				155					160		
Pro	Leu	Arg	Ser	Leu	Leu	Ser	Phe	Asp	Val	Phe	Arg	Ser	Met	Asp	Gln	
			165						170					175		
Gly	Val	Arg	Arg	Phe	Ile	Ser	Asp	Pro	Lys	Leu	Val	Glu	Ile	Leu	Asn	
		180						185					190			
Tyr	Phe	Ile	Lys	Tyr	Val	Gly	Ser	Ser	Pro	Tyr	Asp	Ala	Pro	Ala	Leu	
	195					200						205				
Met	Asn	Leu	Leu	Pro	Tyr	Ile	Gln	Tyr	His	Tyr	Gly	Leu	Trp	Tyr	Val	
	210					215					220					
Lys	Gly	Gly	Met	Tyr	Gly	Met	Ala	Gln	Ala	Met	Glu	Lys	Leu	Ala	Val	
	225				230					235				240		
Glu	Leu	Gly	Val	Glu	Ile	Arg	Leu	Asp	Ala	Glu	Val	Ser	Glu	Ile	Gln	
			245						250					255		

Lys Gln Asp Gly Arg Ala Cys Ala Val Lys Leu Ala Asn Gly Asp Val  
 260 265 270  
 Leu Pro Ala Asp Ile Val Val Ser Asn Met Glu Val Ile Pro Ala Met  
 275 280 285  
 Glu Lys Leu Leu Arg Ser Pro Ala Ser Glu Leu Lys Lys Met Gln Arg  
 290 295 300  
 Phe Glu Pro Ser Cys Ser Gly Leu Val Leu His Leu Gly Val Asp Arg  
 305 310 315 320  
 Leu Tyr Pro Gln Leu Ala His His Asn Phe Phe Tyr Ser Asp His Pro  
 325 330 335  
 Arg Glu His Phe Asp Ala Val Phe Lys Ser His Arg Leu Ser Asp Asp  
 340 345 350  
 Pro Thr Ile Tyr Leu Val Ala Pro Cys Lys Thr Asp Pro Ala Gln Ala  
 355 360 365  
 Pro Ala Gly Cys Glu Ile Ile Lys Ile Leu Pro His Ile Pro His Leu  
 370 375 380  
 Asp Pro Asp Lys Leu Leu Thr Ala Glu Asp Tyr Ser Ala Leu Arg Glu  
 385 390 395 400  
 Arg Val Leu Val Lys Leu Glu Arg Met Gly Leu Thr Asp Leu Arg Gln  
 405 410 415  
 His Ile Val Thr Glu Glu Tyr Trp Thr Pro Leu Asp Ile Gln Ala Lys  
 420 425 430  
 Tyr Tyr Ser Asn Gln Gly Ser Ile Tyr Gly Val Val Ala Asp Arg Phe  
 435 440 445  
 Lys Asn Leu Gly Phe Lys Ala Pro Gln Arg Ser Ser Glu Leu Ser Asn  
 450 455 460  
 Leu Tyr Phe Val Gly Gly Ser Val Asn Pro Gly Gly Gly Met Pro Met  
 465 470 475 480  
 Val Thr Leu Ser Gly Gln Leu Val Arg Asp Lys Ile Val Ala Asp Leu  
 485 490 495

Gln

<210> 19

<211> 22

<212> DNA

<213> Artificial Sequence

<220>

<223> Description of Artificial Sequence:primer

<400> 19

aaggatccgc gtattcgtag tc

22

<210> 20  
 <211> 40  
 <212> DNA  
 <213> Artificial Sequence  
  
 <220>  
 <223> Description of Artificial Sequence:primer  
  
 <400> 20  
 ctggatccga tctagaaata ggctcgagtt gtcgttcagg 40  
  
  
 <210> 21  
 <211> 30  
 <212> DNA  
 <213> Artificial Sequence  
  
 <220>  
 <223> Description of Artificial Sequence:primer  
  
 <400> 21  
 aaggatccta ctcgagctga catcagtgc 30  
  
  
 <210> 22  
 <211> 22  
 <212> DNA  
 <213> Artificial Sequence  
  
 <220>  
 <223> Description of Artificial Sequence:primer  
  
 <400> 22  
 gctctagatg caaccagaat cg 22  
  
  
 <210> 23  
 <211> 954  
 <212> DNA  
 <213> Methylomonas 16a  
  
 <400> 23  
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 attgtcgatc aagccatcga agccttttgt gcgccgattt atgtgcggca cgaggtggtg 120  
 cataaccgca ccgtgggtcga tggactgaaa caaaaagggtg cgggtgttcac cgaggaacta 180  
 agcgatgtgc cgggtgggttc ctacttgatt ttcagcgcgc acggcgtatc caaggaggtg 240  
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Ile	Tyr	Val	Arg	His	Glu	Val	Val	His	Asn	Arg	Thr	Val	Val	Asp	Gly	35	40	45	
Leu	Lys	Gln	Lys	Gly	Ala	Val	Phe	Ile	Glu	Glu	Leu	Ser	Asp	Val	Pro	50	55	60	
Val	Gly	Ser	Tyr	Leu	Ile	Phe	Ser	Ala	His	Gly	Val	Ser	Lys	Glu	Val	65	70	75	80
Gln	Gln	Glu	Ala	Glu	Glu	Arg	Gln	Leu	Thr	Val	Phe	Asp	Ala	Thr	Cys	85	90	95	
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Leu	Val	Glu	Thr	Pro	Glu	Asp	Val	Arg	Asn	Leu	Lys	Val	Asn	Asn	Pro	145	150	155	160
Asn	Asp	Leu	Ala	Tyr	Val	Thr	Gln	Thr	Thr	Leu	Ser	Met	Thr	Asp	Thr	165	170	175	
Lys	Val	Met	Val	Asp	Ala	Leu	Arg	Glu	Gln	Phe	Pro	Ser	Ile	Lys	Glu	180	185	190	
Gln	Lys	Lys	Asp	Asp	Ile	Cys	Tyr	Ala	Thr	Gln	Asn	Arg	Gln	Asp	Ala	195	200	205	
Val	His	Asp	Leu	Ala	Lys	Ile	Ser	Asp	Leu	Ile	Leu	Val	Val	Gly	Ser	210	215	220	
Pro	Asn	Ser	Ser	Asn	Ser	Asn	Arg	Leu	Arg	Glu	Ile	Ala	Val	Gln	Leu	225	230	235	240
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